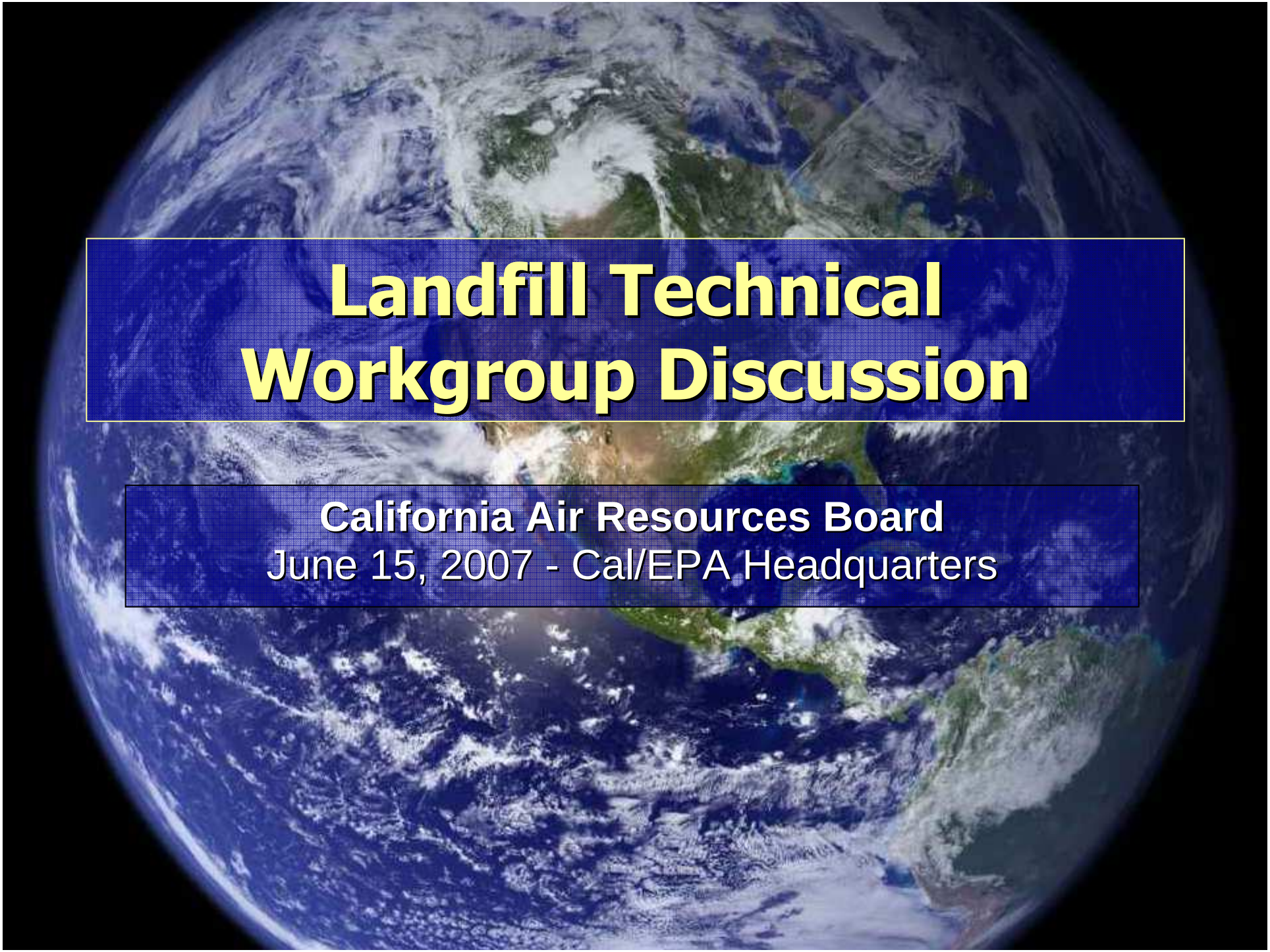


Landfill Technical Workgroup Discussion

California Air Resources Board

June 15, 2007 - Cal/EPA Headquarters

Discussion Topics

- Emissions Inventory
  - Existing Estimates
  - Proposed Methodology
  - Current Estimate
  - Carbon Sequestration
- Mandatory Reporting

ARB Inventory Responsibilities

- Update statewide GHG inventory
- Establish 1990 level and 2020 limit
- Board adoption by January 1, 2008

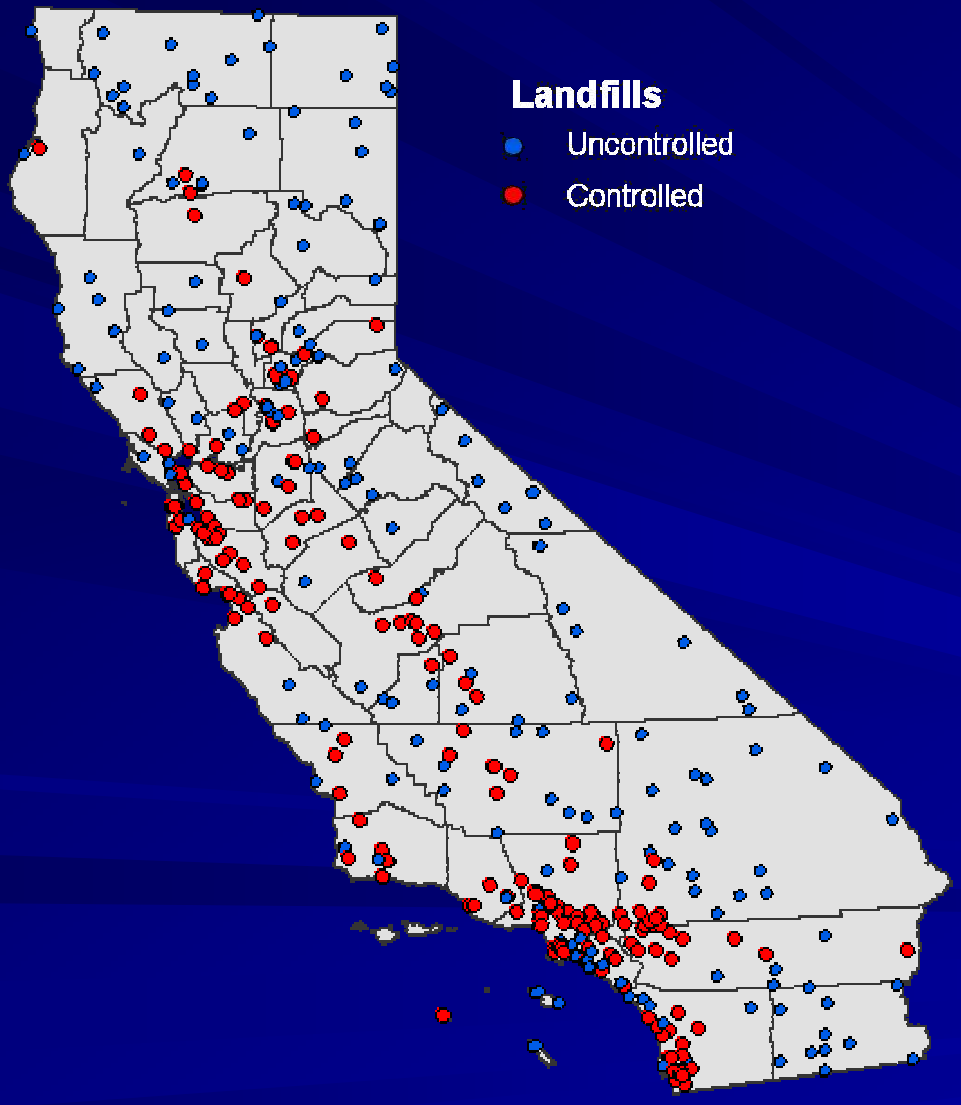
1990 Emissions Level

- Reflects statewide, aggregated annual emissions
- Considers emissions of six “Kyoto gases”
- Express in tons of CO2 equivalents (CO2e)

2020 Emissions Limit

- Equivalent to 1990 emissions level
- Reflects statewide, aggregated annual emissions
- Limit not sector or facility specific
- Remains in effect unless otherwise amended or repealed

California Landfills in 2004



- 370 landfills of concern in 2004
- 180 with active methane control
- Landfills with active control account for 87% of the Waste-in-Place (WIP) and 83% of the emissions in 2004

Existing Landfill Emissions Methodology

- Based on Total Organic Gas (TOG) estimates from local air districts
- TOG consists of CH4 plus other organics (does not include CO2)
- TOG estimates speciated to obtain CH4
- Key assumption: 98.6 percent of landfill gas TOG is CH4

Existing Landfill Inventory Estimates

- CEC estimate of landfill emissions:
  - 8.13 MMTCO2E in 1990
  - 8.45 MMTCO2E in 2004
- No significant variability in emissions over time

Source: California Energy Commission; Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004

Proposed Landfill Emissions Methodology

- Single, consistent approach for updating the landfill emissions
- Decomposition model combined with landfill-specific survey data
  - LandGEM v3.02
  - Initial landfill surveys in April 2007

LandGEM v3.02

$$Q_{CH_4} = \sum_{i=0}^{n-1} \sum_{j=0}^{0.9} kL_0(M_i/10)e^{-kt_{ij}}$$

Q_{CH4} = annual CH4 generation

n = current inventory year – start year

i = one year time increments

j = 0.1 year time increments

L_o = potential CH4 generation capacity

k = CH4 generation rate

M_i = mass of waste accepted in year i

t_{ij} = age of j section of waste mass accepted in year i

ARB Landfill Survey

- Surveys received from 25 landfills to date (40% of the current 2005 WIP)
- Survey data
  - Verification of WIP
  - Collection system installation
  - Landfill gas collected and combusted
  - Type of combustion devices
  - CH4 destruction efficiency
  - %CH4 content of landfill gas by year

Data Inputs for Proposed Methodology

- Annual waste acceptance rates by landfill
- Startup and closure years of landfill
- L_0 and k factors
- Installation year of landfill gas collection system

Data Inputs *(cont.)*

- Additional data inputs based on surveys
  - Amount of landfill gas collected for given year
  - Annual average CH4 content of landfill gas
  - CH4 destruction efficiency if gas is not vented
  - Landfill specific collection efficiency
  - Landfill specific cover soil oxidation factor

Calculating Landfill Emissions

- Landfill CH4 emissions, by landfill, estimated using LandGEM v3.02
- If available, landfill-specific calculations will replace model outputs

[Landfill Specific LFG (mmscf) x CH4% x (1-CE%)/CE% x (1-OX%) + Landfill Specific LFG (mmscf) x CH4% x (1-DE%)] x [20.23 metric tons CH4 per mmscf of CH4] x [GWP* of CH4]

Where

CH4% – methane fraction of landfill gas *(default= 50%)*

CE% – collection efficiency of landfill gas collection system *(default= 75%)*

OX% – oxidation percentage of escaping methane *(default= 10%)*

DE% – methane destruction efficiency of control device *(default= 98%)*

**IPCC Second Assessment Report GWP for methane = 21*

Current Estimates

- Current landfill emissions based on proposed method:

	Landfill Emissions of CH4 (MMTCO2e)		
Year	**Generated**	**% Control**	**Emitted**
1990	14.53	52%	*6.98*
2004	22.75	72%	*6.31*

- Reductions in landfill emissions from existing CEC estimates:
  - 1.15 MMTCO2E in 1990
  - 2.14 MMTCO2E in 2004

Landfilled Carbon

- Previous GHG inventory from CEC considered landfilled carbon, i.e., wood waste, as sinks within the landfill sector
  - Double counting
  - Sink v. stored carbon
- Evaluating carbon stored in landfills
  - Avoided emissions
  - Information item

Landfilled Carbon *(cont.)*

- Staff proposes that landfilled wood waste not be treated as a sink in the landfill sector
- As proposed, landfilled carbon will neither add to nor subtract from the accounting of GHG emissions in the landfill sector

Mandatory Reporting Options

Rationale for Mandatory Reporting

- Very large uncertainty in GHG emissions estimates from landfills
- No protocol currently exists for standardized emissions reporting
- Data collection can inform policymakers and reduce uncertainty– assist protocol development

Rationale for Mandatory Reporting

- Landfill emissions reductions identified as an ARB Early Action priority
- CIWMB has identified data gaps
- Emissions monitoring and data collection will help strategy development
  - Monitor early action reg impacts

Who would be required to report?

- Municipal solid waste landfills that have mandatory gas collection systems
- ~200 of the 370 methane-producing facilities

What types of data may be required?

- Data gaps were identified in three general areas

1. *Gas capture and control systems*:
   - Volume captured, percentage of CH_4, CO_2, non-methane organic gas (NMOG)
   - Amount gas combusted or shipped
   - Best estimates of collection efficiency and conversion of CH_4 to CO_2
   - Percentage of landfill area covered by collection systems and cover materials

What types of data may be required?

2. *Waste-in-place estimates*:
   - Tons of total waste in place
   - Percentage waste in working face and areas where gas recovery systems are not yet installed/active
   - Tons of waste delivered in reporting year
3. *Surface monitoring:*
   - Fugitive emissions data required under federal (EPA NSPS) and State (Early Action) requirements

Next Steps

- Release documentation of existing inventory by sector and draft updates
- Determine 1990 emissions level
- Develop staff recommendations for mandatory reporting
- Hold public workshop for feedback

Proposed Schedule

- July 2007
  - Release inventory documentation and updates
- August 2007
  - Public Workshop
- Early Fall 2007
  - Draft staff report
- November/ December 2007
  - Board consideration of GHG inventory and 1990 level / 2020 limit in public hearing

Comments or Questions?

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GHG Inventory / Mandatory Reporting Website
http://www.arb.ca.gov/cc/ccei/ccei.htm